WHITEPAPER
TECHNICAL PAPER

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ITxPT and Information Technology Standards for Public Transport

Delivering flexible, advanced Intelligent Transport Systems through Open Standards

by David Panter, Industry Solutions Manager, Trapeze Group

Executive Summary

Nothing stays the same forever, and in today's world, transport authorities routinely contract out services to multiple operators with a range of vehicles and system suppliers. To provide a consistently high level of service delivery for passengers, whilst allowing for continuous change, the different systems on a vehicle must work together.

Open standards simplify the coordination and communication between different systems by providing a common language for the required data exchange. A by-product of selecting suppliers and systems that conform with these standards is typically more simplified interface testing, more predictable integration outcomes, and ultimately, lower overall implementation costs.

Information Technology for Public Transport (ITxPT) is an open standard that is now becoming widely adopted. Built specifically to address the needs of the public transport industry, ITxPT is a standard that when incorporated into an enterprise architecture, enables a higher level of supplier independence for on-board, over-the-air and back-office IT systems.

By developing, maintaining, and advancing these standards and practices, ITxPT supports integrated and standardised mobility services for the public, and enhanced interoperability between different IT systems. It defines how vehicle devices communicate, the types of plugs they should use, and other crucial interoperability details.

ITxPT promotes improved cost-efficiency of IT systems and their deployment while ensuring openness and competition in the public transport IT market. ITxPT evolves with new versions, including upcoming specifications for electric vehicles, demand-responsive transport, and more.

In this technical whitepaper, we outline the origins of ITxPT, where it is today, and how transport authorities and operators can commence using the standards. It also explains how Trapeze collaborates with ITxPT to provide and promote standards that enable more efficient and cost-effective adoption of new innovations – delivering more solution flexibility through enhanced levels of supplier independence.

ITxPT
INFORMATION TECHNOLOGY for PUBLIC TRANSPORT

Trapeze is an ITxPT Principal Member. We actively contribute to ITxPT Committees and Working Groups, and our Intelligent Data Router is ITxPT certified.

Background

About ITxPT

ITxPT is an architecture for interoperability designed by a global community of IT suppliers, vehicle manufacturers, transport authorities, and public transport operators. The ITxPT organisation emerged from the EBSF (European Bus System for the Future) project. From nine founding members in 2013, ITxPT membership has increased rapidly to over 140 organisations. ITxPT is an independent group and is registered as an international non-profit association with strong UITP links, as UITP was a founding member. Trapeze has been an ITxPT Principal Member since 2016.

What are the Current IT Challenges for Public Transport?

When multiple systems must work together – sharing data and resources – operators face several challenges. One major challenge is having enough space to mount the equipment required. Every additional system needs cables for Input/Output, power, and communications. This is especially so on older vehicles where there is limited space to run cables. Additional roof penetrations are not desirable, and the glands for existing penetrations are often full.

Each system requires a power supply that is sourced from the vehicle. On older vehicles, the primary power supply is often near capacity, restricting the use of additional systems. Each system also has a set of connectors. Replacing an older system can be expensive as each set of bespoke connectors needs rewiring.

Historically, public transport systems have relied on proprietary solutions. Many systems require location information, engine management data, and separate communications infrastructure for their own back-end system. This approach creates parallel infrastructure that, in extreme situations, has resulted in six computers on a vehicle with multiple antennas, each with complex cabling (Figure 1).

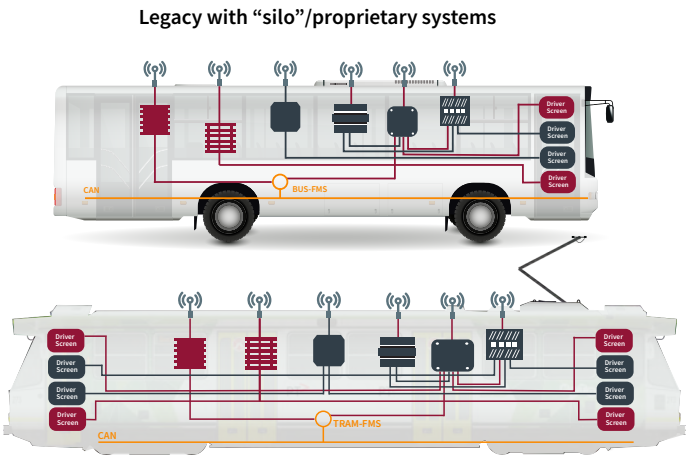


Figure 1 Use of proprietary systems: many data streams run in parallel, with several displays installed at the driver’s end

The Solution – Open Standards

To address these extreme situations, future IT systems require an open architecture based on defined standards. The goal is to have one communication gateway and antenna used by multiple systems that communicate with their own backend. Ultimately, this results in an integrated network for the monitoring and management of all devices, and integrated systems.

ITxPT simplifies the connection between these devices. Since data is sourced from different suppliers, and systems require replacement at different times, a system-independent interface allows for upgrades without impacting other services.

The interface also is extendable to allow for new features. An ITxPT compliant vehicle enables communication with all installed systems, modules, equipment, and back-office systems.

This creates an open and standardised ITxPT architecture, as shown in Figure 2.

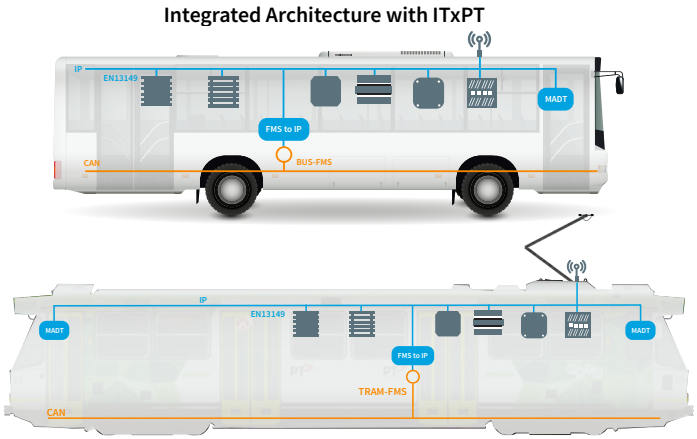


Figure 2 Integrated architecture with ITxPT: the data streams are bundled with only one display is installed for the driver

Current and future in-vehicle functionality benefiting from improved interoperability includes:

- Automatic Vehicle Location (AVL)
- Ticketing
- Visual and acoustic passenger information
- Support for people with disabilities
- Automatic passenger counts
- Traffic light priority
- Multimedia systems
- CCTV
- Safety and anti-collision systems, and
- Driver breathalysers

The ITxPT Solution

ITxPT aims to standardise all aspects of public transport IT systems. It supports the implementation of standards and procedures for integrated 'plug-and-play' IT systems for all vehicles used in public transport and the relevant back-office functions. The ITxPT specifications are available at the ITxPT Documentation Center, and registration is free.

ITxPT brings cost benefits and improves services for passengers by making it easier to deliver real-time information and eliminating proprietary technology silos. Since ITxPT supports innovation, public transport stakeholders will also benefit in ways that have not yet been considered.

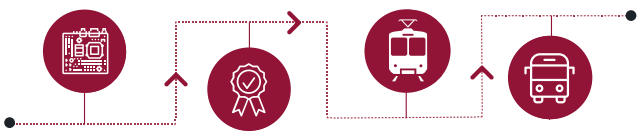
There are four main areas that ITxPT seeks to influence to achieve this:

- Installation requirements (for vehicles and hardware modules)
- On-board architecture (architecture of the function blocks in the vehicle)
- Back-office architecture (architecture of the control centre), and
- Over-the-air architecture (communication protocol)

Each area of the standard may contain several specifications

For example, the installation requirement includes interfaces for:

- The power supply with a defined common plug
- CANbus data
- Audio, with signals available and plugs to be used
- Wireless communications, with common connectors
- Auxiliary equipment, including battery, odometers, door open, stop request, and others
- An onboard IP network, including ethernet plugs and cables, and
- How these various interfaces are all presented in an enclosure



Each specification can be further broken out where needed. For instance, the onboard architecture has specifications for:

- S02P00 Networks and Protocols
- S02P01 Inventory
- S02P02 Time
- S02P03 GNSSLocation
- S02P04 FMStoIP
- S02P05 VEHICLEtoIP
- S02P06 AVM
- S02P07 APC
- S02P08 MADT, and
- S02P09 MQTTbroker

An increasing number of new vehicles will be specified as ITxPT compliant and will be ready for fitting ITxPT compliant modules. However, functionality will also be needed over existing fleets. The **minimum** requirements for retrofitted vehicles with ITxPT compliant architecture are:

Onboard Backbone IP Network, which uses Standardized ITS Architecture (EN13149)

Vehicle Communication Gateway – VCG

GNSS Location service, and

Multi-Application Driver Terminal – with MADT service (if driver display is required)

Integration can be achieved more quickly and easily with standard, non-proprietary interfaces.

ITxPT Standards

ITxPT is actively involved in the CEN standardisation group TC278 WG3, which also deals with IT systems for public transport. This involvement enables ITxPT to inform and promote public transport standardisation and ITxPT-compliant solutions.

While more work is required, the standards achieved to date are a solid foundation for future vehicle hardware and platforms standardisation.

ITxPT has a strong dynamic due to the active participation of transport companies that work with manufacturers to demand effective and efficient project implementations. Standards and specifications are influenced by designs, prototypes and project experience. Company expertise from different sectors converges at ITxPT, and results in a large source of collective knowledge.

Technical specifications are agreed by the ITxPT Working Groups, with involvement from industry representatives and operators who have extensive expertise and practical experience. This collaborative approach is the focus of ITxPT. In 2020, four working groups with a total of 112 people from 52 companies were active. These working groups are the key resource for technical progress, and provide input for specifications, testing procedures and strategic development.

How to Tell if a Device is ITxPT Compliant

Compliant devices will display an ITxPT label that certifies that devices and associated services comply with technical specifications. As standards and specifications are open to interpretation, a single standard can lead to several implementations – which means there is a risk that interoperability will not occur. The ITxPT labelling system avoids this situation by having a common site that interprets the standards.

As new devices are developed, the labelling process declares compatibility with ITxPT specifications (Figure 3). Laboratories in Paris and Gothenburg are available for this purpose, and clearly defined processes must be followed. There are now more than 50 labelled systems in the ITxPT catalogue, with more applications being processed.

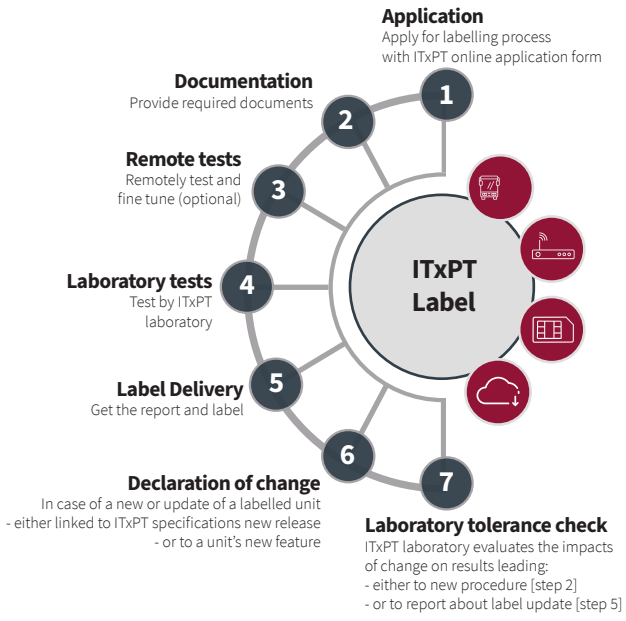


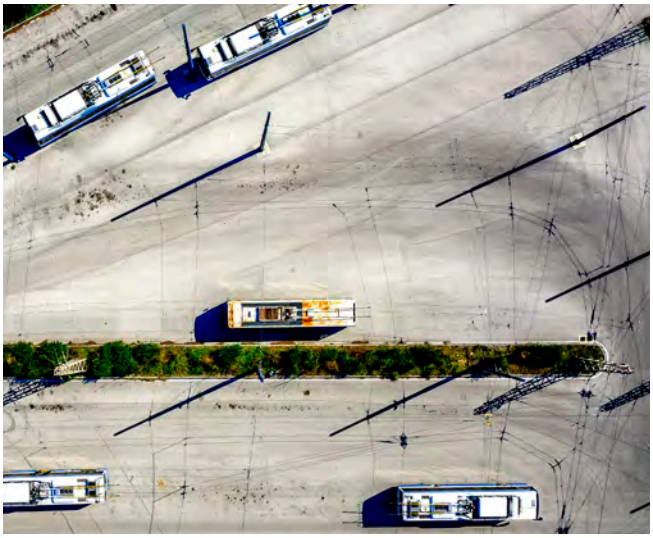
Figure 3 The ITxPT labelling process

Trapeze and ITxPT

Trapeze is an ITxPT Principal Member and plays a leading role in the definition and implementation of ITxPT standards. We actively contribute to ITxPT Committees and Working Groups, and were heavily involved in the air interface specification (S03) and significantly contributed to the new versions of the FMStoIP and APC specifications. Trapeze is also a primary contributor to the new data-centric approach and e-bus specifications.

In terms of Trapeze hardware and software, ITxPT labelling for the Trapeze Intelligent Data Router (IDR) occurred in Paris in 2019. This labelling certified the ITCS vehicle hardware (interfaces, cables, etc. (S01)) and basic software with a range of different services (S02):

- The hardware meets the basic requirements (S01), and
- The following software services (S02) were certified:
  - Module Inventory (module status)
  - Time (time reference)
  - GNSS (location)
  - FMS2IP (CAN-FMS IP based)
  - Vehicle2IP (data from vehicle computer)
  - AVMS – Advanced Vehicle Monitoring System Services (ITCS data), and
  - MQTT broker



Trapeze has also developed and deployed the APC service, which is yet to be labelled. This service makes the IDR suitable for both new and retrofitted ITxPT applications, and significantly limits risk for transport authorities and operators during the integration phase.

In regards to Intelligent Transport Systems (ITS), a fully modular Automatic Vehicle Location and Control (AVLC) system, where the application software of several providers seamlessly interacts, is a future vision. For instance, work is required to harmonise content management systems for passenger information systems and to ensure ITxPT protocols support powerful cybersecurity features.

The systems integrator plays a key role in enabling this outcome within modular systems, and Trapeze, as an experienced and competent supplier, is particularly well suited for this.

As ITxPT standards evolve, Trapeze is implementing these additional standards, and our field experience of integration with other vendors provides feedback to develop them. For example, the APC standard was developed from Trapeze contributions and is supported in the Trapeze IDR.

Future 5G implementations will stimulate development of standards that support a service-oriented model instead of a data-centric one. This model makes it possible to implement multiple services on a vehicle, using lightweight appliances and shared, high-speed communications.

Conclusion

There is now a critical mass for all in-vehicle and peripheral purchases to use the ITxPT standards. Leading vehicle manufacturers are ITxPT ready, with new vehicles prewired to meet these standards. Many industry leaders have already developed hardware that meets the ITxPT standard, and more are in the process of being certified.

It is in the interest of transport authorities and operators to specify that the ITxPT label is required in tenders and/or specifications for new or retrofitted vehicles. This approach will provide benefits to public transport systems and empower suppliers to innovate and deliver better services for passengers.

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Trapeze Group works with public transport agencies and their communities to develop and deliver smarter, more effective public transport solutions. For more than 25 years we have been *Here for the Journey*, evolving with our customers around the world to help them move people from point A to Z and everywhere in between.

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